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ABSTRACT

The results of this study were a series of propositions dealing with the cost-effectiveness of instructional technology. The propositions were developed by collecting and sythesizing existing studies on the subject through use of a propositional inventory research design. Approximately three hundred studies were reviewed and evaluated in terms of the established criteria. The propositions will become guidelines that educational decision makers can use when considering the use of instructional technology. (Author)

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A PROPOSITIONAL STATEMENT ON THE COST-EFFECTIVENESS OF INSTRUCTIONAL TECHNOLOGY

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Colleges and universities across the country are currently facing critical financial problems. As reflected in most sectors of society the resources available for post-secondary education are not meeting the expenses. In a recent issue of the Chronicle of Higher Education the problem is described as follows:

> In the battle of the budget, some of the nation's top universities and several statewide systems of higher education have given up on holding the line. From Harvard to Stanford, Florida to Wisconsin, they are cutting back. (Magarrell, 1975, p.3)

This situation is not limited to any particular type of institution but is found at some level at virtually all institutions of higher education.

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Institutions are meeting the financial crisis primarily by utilizing short-range stop-gap solutions. Among those being utilized now are the following: 1) delay of non-essential building repairs, 2) elimination of non-productive programs, 3) elimination of faculty positions, 4) decrease in the budgets of all departments, and 5) postponement of faculty raises.

Higher education must find long-range solutions to the financial crisis; otherwise it will continually need to find new short-range solutions for financial problems. If the long-range solution is to be a real solution, then the current structure of higher education, particularly the organization of instruction, must change.

Instructional Technology as a Solution

Many leading educators have been suggesting instructional technology as a means by which institutions of higher education can meet, at least in part, the current financial crisis. Perhaps the most powerful suggestion is contained in the Carnegie Commission on Higher Education report entitled The Fourth Revolution: Instructional Technology in Higher Education.

> Although short-run costs for the development and introduction of new instructional technology are expected to be very great, they will ultimately yield dividends. Much of the expanding technology has the potential economic effect of spreading the benefit of investment in a single unit of instruction among very large numbers of students. It therefore has an ability to increase the productivity of

> higher education. The earlier efforts are made to develop the expanding instructional technology fully, the earlier this increased productivity will be realized [1972,pp. 45-46].

Statements parallel to this propounding the cost-effectiveness of instructional technology have been made by other groups and individuals.

Educators, however, must be careful that the adoption of instructional technology will in fact be cost-effective. Given the current economic situation in higher education we can not afford to make adoptions which are not cost-effective. Since there is a relatively substantial literature base dealing with the cost-effectiveness of instructional technology, the adoption of such projects can be made with a reasonable anticipation of success.

This literature base, however, has not been collected and synthesized to provide a guideline for designing instructional programs that are cost-effective. Hence the purpose of this study.

Purpose of This Study

The purpose of this study was to formulate a list of propositions pertaining to the cost-effectiveness of instructional technology by collecting, analyzing and synthesizing existing studies that deal with the subject. To achieve this purpose a propositional inventory research design was employed to develop the propositions listed in this report.

Methodology

The propositional inventory research design has been used in a number of sociological studies. Three of these studies, those by Collins and Guetzkow (1964), Rogers and Shoemaker (1971), and Merton (1968), served as the models for the design in this study.

The first step in the methodology was the development of a bibliography of all the studies which measured the cost-effectiveness of instructional technology. The initial bibliography consisted of four hundred and twenty-nine references. Of this number approximately three hundred were evaluated in terms of two criteria. The first criterion was that the study must deal with the cost-effectiveness of instructional technology. The second criterion was that the study had to be either an empirical study or its findings had to be supported with quantitative data. From the thirty-two studies that met these criteria, fifteen propositions were formulated which encompassed the findings of the studies.

Generalizability of the Propositions

The propositions are generalizable only to situations similar to the situations in the studies which support each proposition. Therefore, the generalizability of each proposition will be different from the others. For example, propositions numbered 1A and 1B, dealing with the class size for closed-circuit Television,

are supported by studies which were conducted at institutions of higher education. These propositions are generalizable to institutions of higher education only. Proposition number 8, dealing with savings in learning time, is supported by studies done in both higher education and elementary education. Therefore, proposition 8 is generalizable over more levels of education than propositions 1A and 1B.

Several of the propositions are supported by studies done in countries other than the United States. If the findings of these studies were markedly different from the findings of the studies conducted in the United States there would be grounds for questioning whether the foreign studies were generalizable to situations in the United States. The findings, however, of the studies supporting these propositions were parallel regardless of the nations in which the studies were done. Thus, the studies included in this research project that were conducted in countries other than the United States tend to be generalizable to the United States.

Similarly, there may be concern over the reliability of studies which were conducted a number of years ago. As with the findings of the foreign studies, the studies done as many as fifteen years ago had findings that were parallel to the findings of more recent studies. For example, proposition number 11, dealing with the decrease in cost per student when the number of students is increased, is supported by studies done during the period from 1958 to 1971. The findings of all

the studies related to proposition number 11 are consistent.

Since, neither the country of origin nor the date of the studies appear to cause a variance in the support of the propositions the generalizability for each is controlled by the types of situations in which the studies were conducted.

List of Propositions

The following list of propositions is the product of the execution of the research design described previously.

Class Size for Closed-Circuit Television

Proposition Number 1A. The cost of providing instruction through use of one instructor lecturing to thirty students will be less than the cost of utilizing closed-circuit television when the total course size is less than two hundred students.

Proposition Number 1B. The cost of utilizing closed-circuit television for classroom instruction will be less than the cost of providing instruction through the use of one instructor for each thirty students when the total course size is greater than five hundred students.

The size of the group for which closed-circuit television (CCTV) is being considered as an instructional strategy is an important consideration. When CCTV is utilized, costs are incurred for such items as television cameras, control equipment, television receivers and the personnel to produce the programs and operate the equipment. The savings that result by using one instructor for the entire group rather than one instructor for each thirty students must offset these CCTV costs in order for the system to

be cost-effective.

The findings of the four studies related to this proposition conducted at Pennsylvania State University (Carpenter and Greenhill, 1958), Purdue University (Brown and Thornton, 1963, p. 55), Rensselaer Polytechnic Institute (Brown and Thornton, p.40), and Michigan State University (Jones, Johnson, and Dietrich, 1969), all support both propositions 1A and 1B.

Class Size for Open Circuit Broadcast

Proposition Number 2. The cost of utilizing open circuit television for instruction will be less expensive than the cost of providing instruction through the use of one instructor for each thirty students when the total course size is greater than nine hundred and fifty (950) students.

As with propositions 1A and 1B dealing with CCTV, the group size is important for open circuit broadcast. Open circuit broadcast entails many of the same costs which were listed for CCTV such as cameras, control equipment, and the personnel to produce the programs and operate the equipment. Open circuit broadcast, however, does not pay for the television receivers but instead must pay the costs of a transmitter and a tower. The costs for transmission tend to raise the costs for open circuit broadcast substantially above the costs for CCTV. Therefore the group size must be larger for open circuit broadcast to be cost effective. The report of a study done at San Francisco State College stated that:

> the cost experience of these experimental professionally presented open-circuit TV courses showed that . . . it is economically feasible to offer lecture discussion courses by television with enrollments of 950 students [Brown and Thornton, p. 67].

Airborne Television

Proposition Number 3. Airborne transmission facilities can distribute television signals at a cost less than any other distribution system over relatively flat territory if the area to be covered is greater than 150,000 square miles.

Soverign (1965) studied the costs of this system in comparison to the costs for a land based transmitter. He found that an airborne broadcast system costs $8.38 per square mile for one channel and that a ground based broadcast system costs $13.73 per square mile. The savings become even more dramatic when signals are broadcast on more than one channel. The costs for an airborne system with six channels were $15.72 while the costs for a ground based system employing six channels were $50.35.

Shared Broadcast Facilities

Proposition Number 4. The utilization of existing broadcast facilities on a part-time basis for educational broadcasts will reduce the otherwise necessary capital expenditure for the education institution.

The capital expenditure necessary to establish a broadcast facility (television or radio) is large. Equipment such as cameras, recorders, control room equipment, transmitters, as well as the building to house the equipment and the tower to support the

antenna must be purchased before the station can broadcast a signal. By utilizing existing broadcast facilities on a part-time basis the educational institution pays to the owner of the shared broadcast station an amount equal to a percentage of the capital costs which corresponds to the percentage of time which they use the facility.

The findings of the four studies (McCombs, 1967; Lyle, et. al., 1967a; Kinane, et. al.,1967; Lyle, et.al., 1967b) related to this proposition all support the proposition. One of the studies was conducted in the United States and the other studies were conducted in the foreign nations of Peru, Australia and Colombia.

Sixteen Millimeter Films

Proposition Number 5. The rental of sixteen millimeter films from a centralized film library is more economical than the ownership of the films by local school districts.

The question of whether a school system should purchase a 16mm film or rent the film when needed has been discussed many times by instructional technology specialists (Gjerde, 1965; Mulvihill, 1971, Caffarella; 1974). This proposition suggests that it may be more cost-effective for school districts to rent sixteen millimeter films rather than to own the films.

Amplified Telephone

Proposition Number 6. The utilization of an amplified telephone interview can provide guest lecturers at a cost less than

the cost of bringing the person to the class for an 'in-person' lecture.

The faculty of Stephens College experimented with the use of amplified telephone lectures as early as 1958. A report of their experience with amplified telephone lectures contains the following statement.

> Amplified telephone interviewing provides a useful new dimension to teaching and learning. Its flexibility ranges from the student-directed interview to the tele-lecture (an eminent authority lecturing for most of a period). It brings men and events to the classroom at a moderate cost . . .[Brown and Thornton, p. 100].

Production of Instructional Technology Materials

Proposition Number 7. The costs of instructional technology vary with the level of sophistication of the production.

The costs for producing educational materials can vary from a very low to a very high cost. The production of a teacher made audio-tape, a low level of sophistication, may cost only a few dollars while a television production such as The Electric Company, a highly sophisticated program, costs several million dollars. This finding is supported by three studies (Tickton, 1970, pp. 84, 85; McConeghy, 1966).

Student Time

Proposition Number 8. The use of instructional technology can result in savings in student learning time.

The amount of time a student spends obtaining his/her education is a cost factor many times overlooked. If the amount of

time a student spends in college can be reduced then savings can be realized by the educational institution and society as well as the student. Since students will need to spend less time in class, the institution can add new students to occupy the spaces that the students already enrolled will no longer need. Society benefits by having a person, with needed skills, gainfully employed in a shorter period of time. The student benefits by expending less time obtaining an education thereby entering the work force sooner. Four studies (Brown and Thornton, p. 50; Allred, 1967; Plotkin, 1963; Eurich, 1969) support this finding.

Increase in the Student/Faculty Ratio

Proposition Number 9. Educational institutions can increase their student/faculty ratios through the use of instructional technology.

The Academy for Educational Development recently conducted a study that examined colleges having a student/faculty ratio which is 20 to 1 or higher. Behrens (1972) in the report of that study stated that at least 80 colleges and universities have student/faculty ratios in excess of 20/1. The study also found that a large number of the institutions were using instructional technology to help maintain quality with a relatively high student/faculty ratio.

Institutional Savings

Proposition Number 10. The utilization of instructional tech-

nology can result in actual dollar savings to educational institutions.

This proposition is a general proposition which states that the costs of operating educational institutions can be reduced by utilizing instructional technology. The proposition is supported by three studies (McCombs, 1967; Brietenfeld, 1971; Eurich and Schwenkmeyer, 1971).

Audience Size

Proposition Number 11. As the number of students increases the costs per student decrease when instructional technology is utilized.

The actual costs for providing instructional technology services remain relatively constant regardless of the number of students who use the instructional technology. For example, it costs the same amount to show a 16mm film to one student as it does to show the same film to fifty students.

Seven studies (Carpenter and Greenhill, 1958; Johnson and Dietrich, 1971 Lafranc, 1967; Lyle, et.al,1967c; Schramm, et.al. 1967, Schramm, et.al. 1967b; Schramm, et.al. 1967c) were reviewed that compared the relationship between the size of the enrollment in a course and the cost per student for that course. All of the researchers with the exception of Johnson and Dietrich have constructed graphs which show their findings. These graphs have shapes similar to the shape of the graph in Figure 1. Likewise if Johnson and Dietrich's data were graphed, it, too, would resemble the graph in Figure 1.

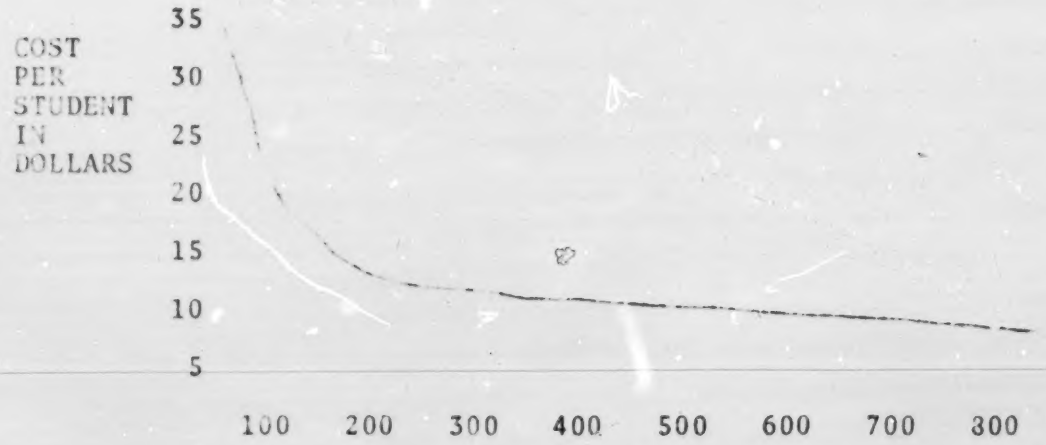

Figure 1. --Cost per student in relation to the number of students enrolled in the course.

Re-use of Materials

Proposition Number 12. The cost per pupil for instructional technology systems can be reduced if the instructional materials are used a number of times instead of being used just once.

This proposition is closely related to proposition number eleven in which it was implied that all students used the instructional technology system at the same time. In proposition twelve the instructional technology materials are re-used a number of times during successive terms.

The results of two studies (Brown and Thornton, p. 67; McConeghy, 1966) showed that educational institutions can reduce the costs of instruction by re-using the same materials a number of times. However, it is vital that the content of the materials should not be allowed to become outdated. If the material is not revised there will be a major reduction in the effectiveness of

the material.

Expanding Opportunities

Proposition Number 13. Instructional technology can provide instruction to students who otherwise, because of time or money constraints, would not be able to receive such instruction.

There are many students who for reasons such as living too far from a school, being geographically isolated or being confined to bed are unable to attend class meetings in traditional school settings. There are also many students who attend schools which are too small to provide specialized subjects. The use of instructional technology can make it possible for these students. to obtain an education that would otherwise be impossible.

The experiences at six educational institutions (Kinane, et.al. 1967; Ewing, 1967; Lyle, et.al., 1967c; Wade, 1967; Wells, 1959; McCombs, 1967) show how instructional technology can provide for students who otherwise would not be able to receive instruction. The two examples from foreign countries on the use of instructional technology to teach students in remote areas, particularily Australia and New Zealand, should be considered as the United States investigates the possibilities of a university without walls.

Enrichment of the Curriculum

Proposition Number 14. Through the utilization of television it is possible to reduce the cost of bringing qualified instructors to areas where the costs otherwise would be prohibitive.

The use of instructional television can reduce the costs of

providing specialized education in schools. In both of the studies (Schramm, et.al., 1967d; Wade, 1967) supporting this proposition, it would not have been possible to attain their educational goal for a reasonable cost without the use of television.

Recommended Research

The current quantity and quality of research on the cost-effectiveness of instructional technology is low. Since only thirty-two of approximately three hundred studies reviewed met the established criteria, it is evident that even though there has been a proliferation of writings in the cost-effectiveness of instructional technology there has been very little research on the subject. Because of the small quantity and low quality of the research there is a need for additional empirical and data-based research regarding the cost-effectiveness of instructional technology.

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